

## PATENT SPECIFICATION

(11) 1 334 772

## DRAWINGS ATTACHED

1 334 772

- (21) Application No. 11172/71 (22) Filed 23 April 1971  
 (31) Convention Application No. P 20 19 947-7 (32) Filed 24 April 1970 in  
 (33) Germany (DT)  
 (44) Complete Specification published 24 Oct. 1973  
 (51) International Classification H01S 3/02  
 B23K 27/00 3/00  
 (52) Index at acceptance  
 H1C 206 208 24Y 26Y 340 34Y 392 393 39Y 401 410 560  
 56Y 57Y 61Y 629 705 70Y 73Y 762 793  
 B3R 21X 22X 31 37A3  
 B3V 4A2



## (54) LASER DEVICE HAVING MEANS FOR PROTECTING THE HUMAN BODY AGAINST HARMFUL RAYS

- (71) We, MESSER GRIESHEIM GMBH, a Company organized under the laws of Germany of Frankfurt/Main, Hanauer Landstr. 300, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 This invention relates to a laser device having means for protecting the human body against harmful rays from the laser beam. In the working of workpieces, for example, particularly in welding, cutting, soldering, heating; heating by means of laser, maser, and light ray devices, the rays supplying the required energy are partly reflected from the working surface. Furthermore, when light ray devices are used, an intensive visible light beam or glare is produced.
- These radiations that occur with the appliances mentioned above are dangerous to the operators and also to anyone watching the operation in the immediate vicinity, since the human eye in particular is damaged by these rays, which cause inflammation of connective tissue and burning of the retina. Moreover, skin burns and internal damage may also be caused.
- For this reason, safety regulations require anyone coming into contact with the harmful rays to wear goggles, guards, or protective helmets and protective clothing or alternatively, protective walls formed from a material keeping harmful rays away from the body must be erected between the operator or viewer and the apparatus emitting the harmful rays.
- 40 The use of protective walls entails several disadvantages. The purchase of such walls is costly and the operation and adjustment of the apparatus in question, for example a CO<sub>2</sub> machining laser, are made difficult.
- 45 Moreover, in order to obtain adequate protection, the entire apparatus must be surrounded by a protective wall of this kind, and thus a viewer is unable to follow the machining operation accurately because it can only be viewed from a distance.

The disadvantages of using protective helmets, guards, goggles, and protective clothing are that these devices hinder the freedom of movement of the operator, make supervision of the work difficult, and cause discomfort to the operator because of the heat produced under these protective devices.

Moreover, it is necessary that every viewer should be provided with protection of this kind, and this is particularly inconvenient in the case of demonstrations.

The object of the present invention consists in providing a laser device with simple means for protecting the human body from harmful rays emitted by an apparatus that is being worked, and enables the operator of the apparatus to work in a simple manner and the machining operation to be viewed near the machining position, without requiring protective measures.

According to the present invention there is provided a laser device having an outlet aperture for the laser beam and protective means for the protection of human beings against laser beams, the protective means comprising a shield or hood which surrounds the outlet aperture through which passes the laser beam, the shield or hood being formed from a material capable of absorbing and/or reflecting the laser radiation, and wherein at least a part of the shield or hood is transparent to visible light allowing harmless light rays to pass through to enable operations carried out by the laser to be observed.

The arrangement according to the invention ensures that the harmful rays are absorbed or reflected by the hood immediately after their production.

The expression "transparent" is used herein to include a material which may be darkened to an extent depending on the intensity of the radiation, but which nevertheless enables the working operation to be observed. For example, a kind of dark coloured glass, such as is used for welders' goggles, may be used.

The hood according to the invention may be made completely of transparent material. It is, however, advantageous for only part of the hood to be transparent. It is also convenient for the hood to be so constructed that replacement of the transparent part is possible. Replacement may become necessary if the transparent part becomes excessively fogged by vapours or excessively damaged by splashes of material.

When working with laser beams, it is not always advantageous for all the rays reflected from the surface being worked on to be absorbed by the hood, but is sometimes preferable that at least some of the rays be returned to the machining point. This produces additional heating at that point.

An additional advantage gained when working with an arc where a protective gas is used is that the hood prevents the current of gas from being blown away. Above all, the invention permits close observation of the working point.

The protective gas used is, in addition, built up in "bell"-like manner inside the hood over the working point. The resulting "bell" of protective gas is also heated by the energy beam performing the work, so that more intensive action of the protective gas and better utilization of the amount of protective gas supplied are achieved.

The hood is preferably adjustable in position on the laser device, that is to say the viewing window (lens) can be adjusted as desired, by turning the hood around the device. The hood may also be adjustable in height, in relation to the outlet aperture. Advantageously, the hood is so constructed that it can be brought into various angular positions.

Furthermore, the hood is preferably in the form of a bell or cylinder or is composed of a disc which has a rim directed towards the workpiece. These constructions are particularly favourable in that they facilitate observation of the working point, while simultaneously adapting the column of gas to different areas to be covered.

When using for example a  $\text{CO}_2$  machining laser, the hood is formed from transparent acrylic glass, since acrylic glass absorbs the wavelengths of a  $\text{CO}_2$  laser beam (10.6  $\mu\text{m}$ ).

For radiations of different wavelengths, appropriate materials should be selected in each particular case i.e. a glass with suitable

colouration or glass with a reflecting and/or filter coating.

It is also possible to form the hood from a material which has so high a melting point that splashes of substances encountering the wall of the hood will not burn into the latter, for example quartz glass.

In order to improve observation of the working point, at least one magnifying lens is preferably disposed in the hood. The operator can thus accurately follow the working process, and make the necessary corrections.

A further modification of the invention consists of providing an exchangeable disc between the radiation producer and the lens. The lens is thereby prevented from being damaged by splashes, vapours or the like.

It is also possible, according to the invention, to provide a protective gas in order to prevent splashes from adhering to the lens or to the transparent part of the hood. The fogging of the lens or of the transparent part can also be prevented by a current of protective gas. Where a protective gas is to be used, a gas supply opening is provided. In addition it is proposed according to the invention that the inside of the hood should be coated by vapour deposition with a splash-repelling coating, for example silicone oil.

A number of embodiments of the invention will now be described in detail by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows the laser device with hood according to the invention;

Figures 2 and 3 show further examples of laser devices having different hoods according to the invention.

Referring to Figure 1, the hood 30 is fastened onto a laser device 31 by means of a screw 45. The beam 33 produced by the laser 32 is diverted by an optical system 34 and directed by way of a processing optical system 35 to a workpiece 36. The processing optical system 35 is disposed in a tube 37. This tube 37 has an inlet 38 through which may be supplied a protective gas, necessary for preventing the formation of oxide during machining (e.g. welding or cutting) of metals or non-ferrous metals. This current of protective gas also removes the vapours forming under the hood. It is also possible for a current of protective gas of this kind to be supplied when other materials are being machined.

In the embodiment of Figure 1, the hood 30 consists of a plurality of segments of magnifying lenses 40, 40', which on their inner sides are provided with a coating of silicone 41 by vapour deposition. This silicone coating prevents any splashes of

3

1 334 772

3

material which may occur from adhering to the lens segments 40, 40', but at the same time permits viewing through the lenses. The rays 43 partly reflected on the surface 42 of the workpiece 36 are absorbed and/or reflected by the hood 30, so that they are prevented from reaching the eyes 44 of a viewer.

Figure 2 illustrates another form of the hood. The hood 50 consists of a disc 51, which is provided with a rim 53 directed towards a workpiece 52. The hood 50 together with a component 54, which in this case is also constructed as a cutting nozzle for a CO<sub>2</sub> gas laser is fastened on the outlet part 55 of a laser.

In a construction of this kind the harmful rays 56 are also prevented from reaching the eyes 57 of a viewer.

The lower side 58 of the disc 51 may be grooved, in order to prevent the harmful rays from being reflected back.

The diameter and the thickness of the disc 51 are varied according to the energy of the laser.

In Figure 3, the hood is in the form of a cylinder 60, which is screwed onto an outlet part 61 of a laser. The cylinder 60 also prevents the human eye 62 of a viewer from being affected by the harmful rays 63.

#### WHAT WE CLAIM IS:

1. A laser device having an outlet aperture for the laser beam and protective means for the protection of human beings against laser beams, the protective means comprising a shield or hood which surrounds the outlet aperture through which passes the laser beam, the shield or hood being formed from a material capable of absorbing and/or reflecting the laser radiation, and wherein at least a part of the shield or hood is transparent to visible light allowing harmless light rays to pass through to enable operations carried out by the laser to be observed.
2. A device as claimed in claim 1, wherein the hood or shield is adapted to be varied in position on the device.
3. A device as claimed in claim 1 or 2, wherein the shield or hood consists of

a disc provided with an annular flange extending perpendicularly to the plane of the disc.

4. A device as claimed in claim 1 or 2, wherein the hood or shield is in the form of a bell.

5. A device as claimed in claim 1 or 2, wherein the hood or shield is in the form of a cylinder.

6. A device as claimed in any one of claims 1 to 5, wherein the hood or shield is completely formed of a transparent material.

7. A device as claimed in any one of claims 1 to 5, wherein a part only of the hood or shield is transparent, and this part is also replaceable.

8. A device as claimed in any one of claims 1 to 5 and 7, wherein the hood or shield is provided with a viewing window or lens.

9. A device as claimed in claim 8, wherein at least one magnifying lens is provided.

10. A device as claimed in any one of claims 1 to 9, wherein an inlet for supplying a protective gas is provided in the hood or shield.

11. A device as claimed in claim 8 or 9, wherein an exchangeable disc is provided between the lens and the emitted rays.

12. A device as claimed in any one of claims 1 to 11, wherein the inside surface of the hood or shield is coated with a splash-repelling coating.

13. A device as claimed in claim 12, wherein the coating consists of silicone oil.

14. A laser device having an outlet aperture for the laser beam and protective means, substantially as described herein with reference to and as illustrated in the accompanying drawings.

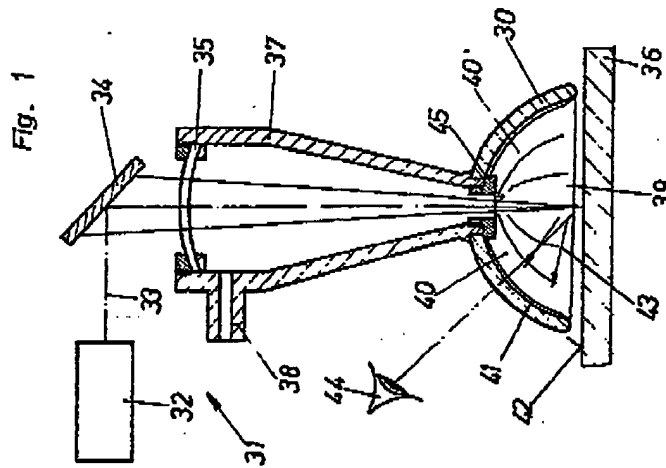
For the Applicants,

CARPMAELS & RANSFORD,  
Chartered Patent Agents,

24 Southampton Buildings,  
Chancery Lane,  
London, WC2.

Printed for Her Majesty's Stationary Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1973.  
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1334772 COMPLETE SPECIFICATION

2 SHEETS  
*This drawing is a reproduction of  
the Original on a reduced scale*  
Sheet 1

1334772 COMPLETE SPECIFICATION

2 SHEETS This drawing is a reproduction of  
the Original on a reduced scale  
Sheet 2